Heart-View

Cardiac Screening Program

EBCT to Screen for Coronary Atherosclerosis in the Military

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Epidemiology

- **Coronary artery disease remains the single leading killer in the Western world**
- **In the United States**
  - **13.5 million have a diagnosis of CAD**
  - **1.5 million myocardial infarctions per year**
  - **500,000 fatal Myocardial Infarctions per year**
  - **Cardiovascular Disease was responsible for 41% of all deaths in the United States**
  - **Estimated economic cost >$90 billion**

Conventional CVD Risk Factors

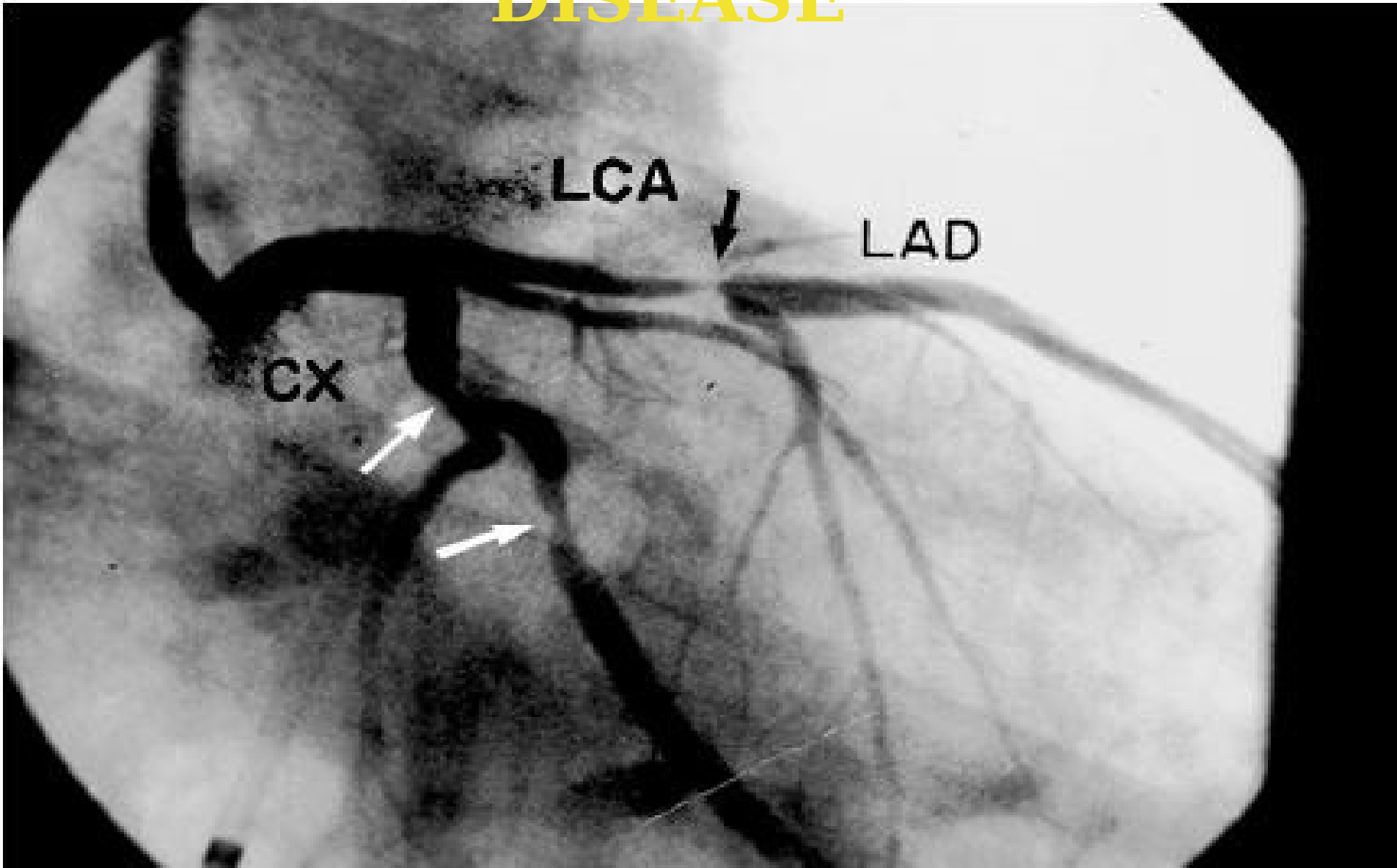
fail to predict 33-50% of future Morbidity and Mortality

Maximal Exercise Treadmil

- What Information does it tell u
- Is it a good cardiac screening

ABNORMAL TREADMILL TEST

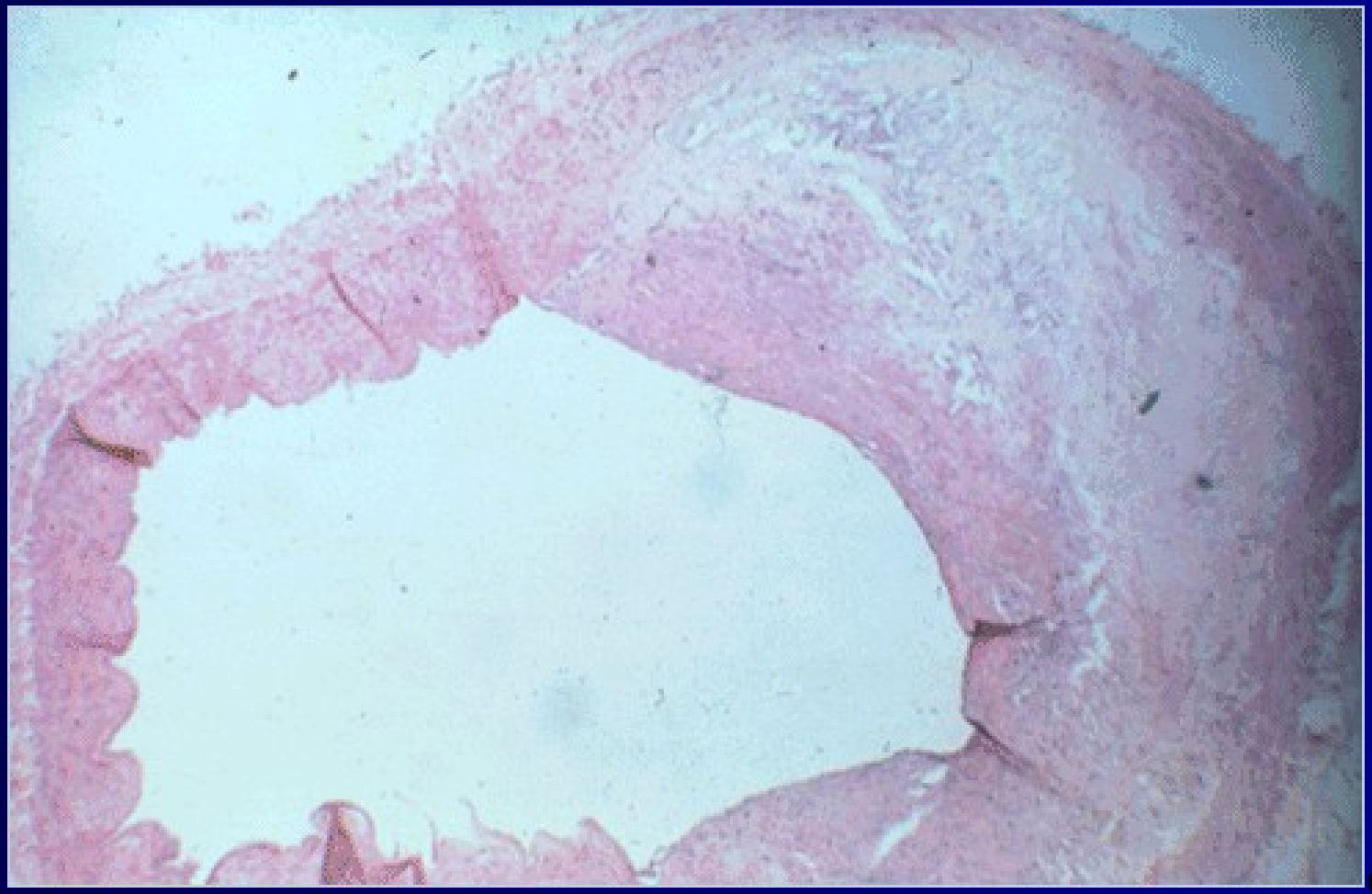
CORONARY ARTERY DISEASE



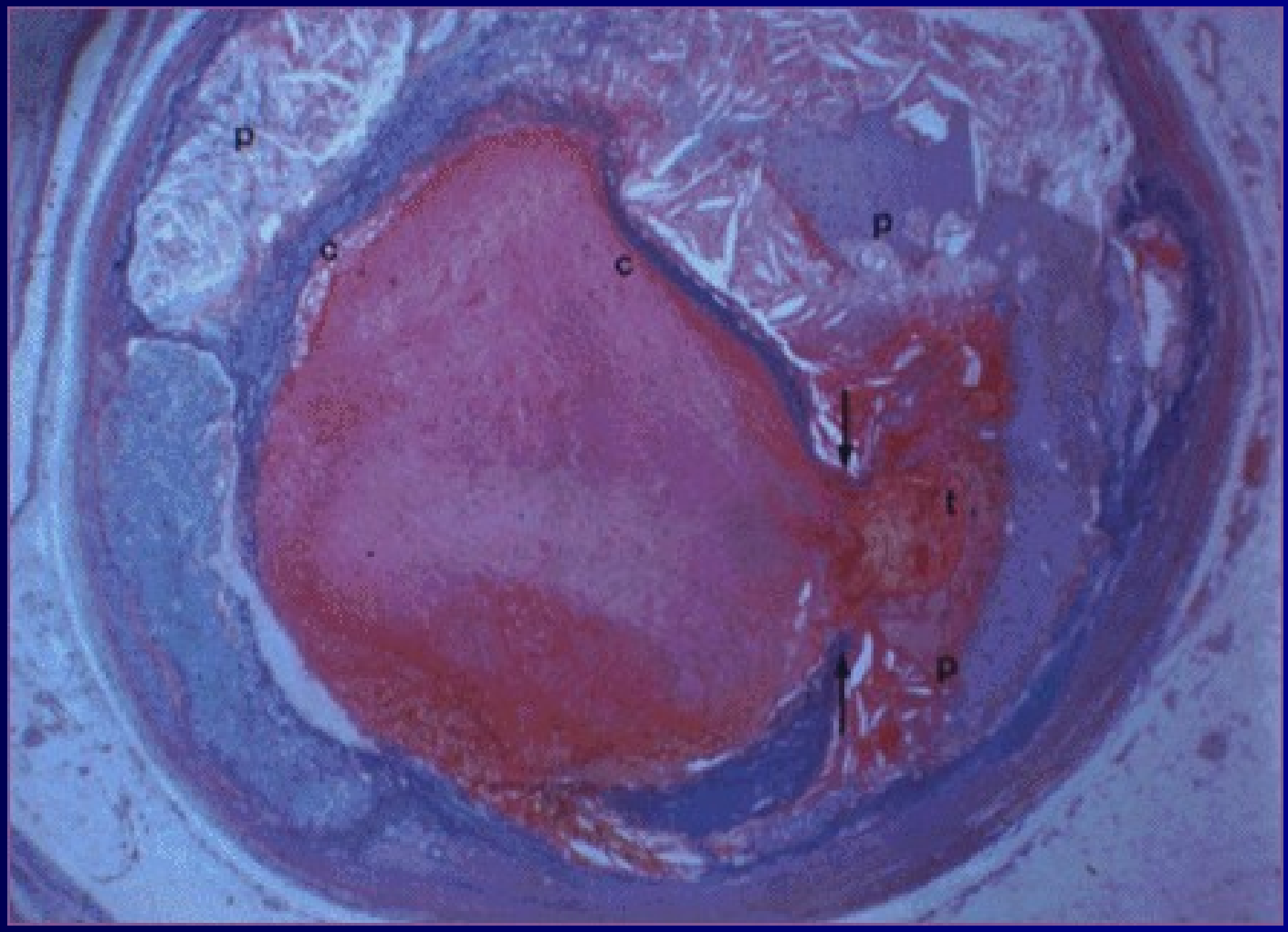
CAD IN THE US ARMY

- Random Autopsies on young soldiers in and Viet Nam demonstrated occult CA occurring at very young ages.
- CAD death rate in US Army in the "Ove population is 1/5000 - 1/2000
- Despite extensive non-invasive strategi try to reduce the incidence of CAD deat CAD remains the leading cause of non- related morbidity and mortality in the U middle aged soldier.

Uncomplicated Atherosclerosis

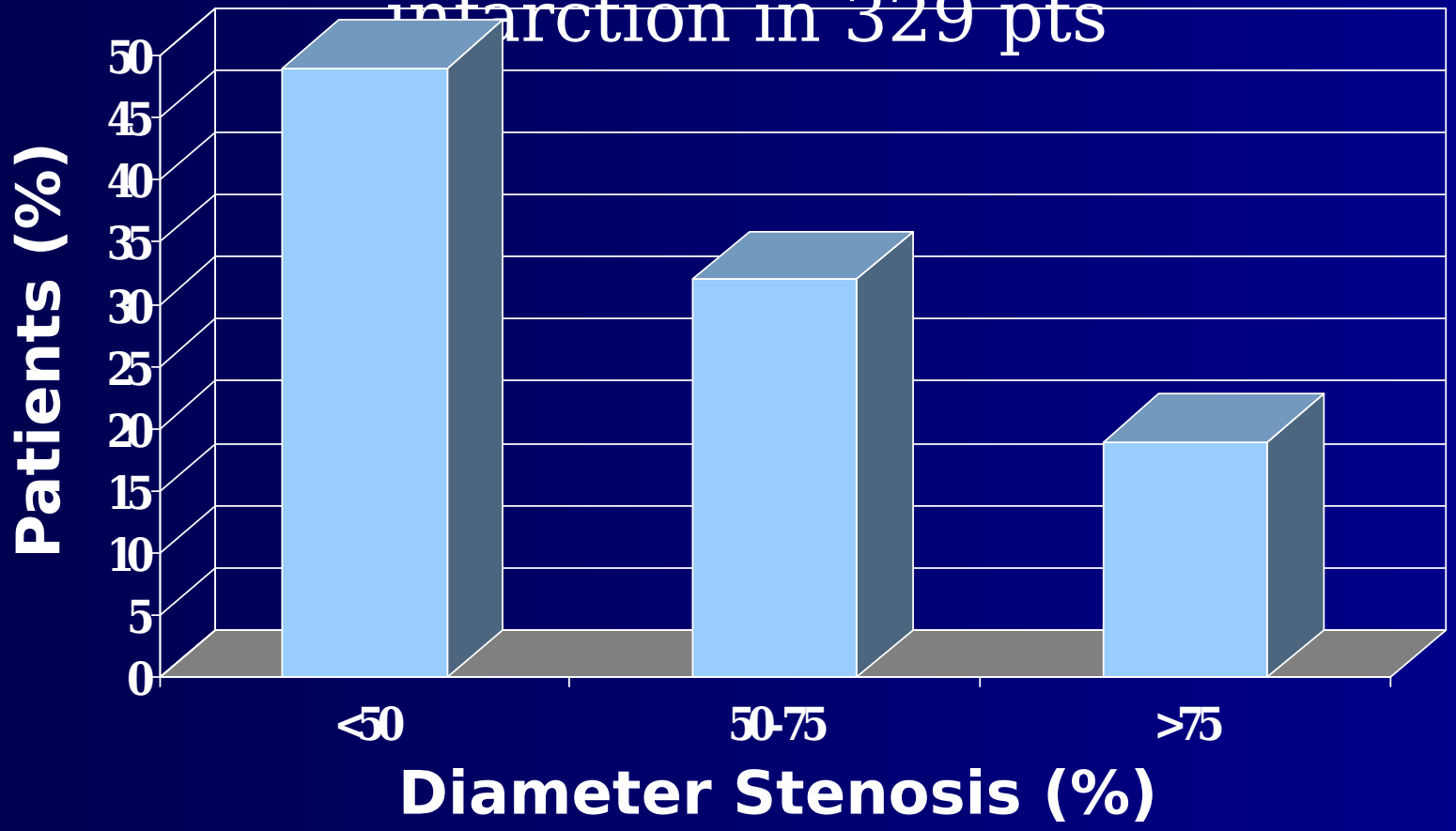


Complicated Plaque with Thrombosis



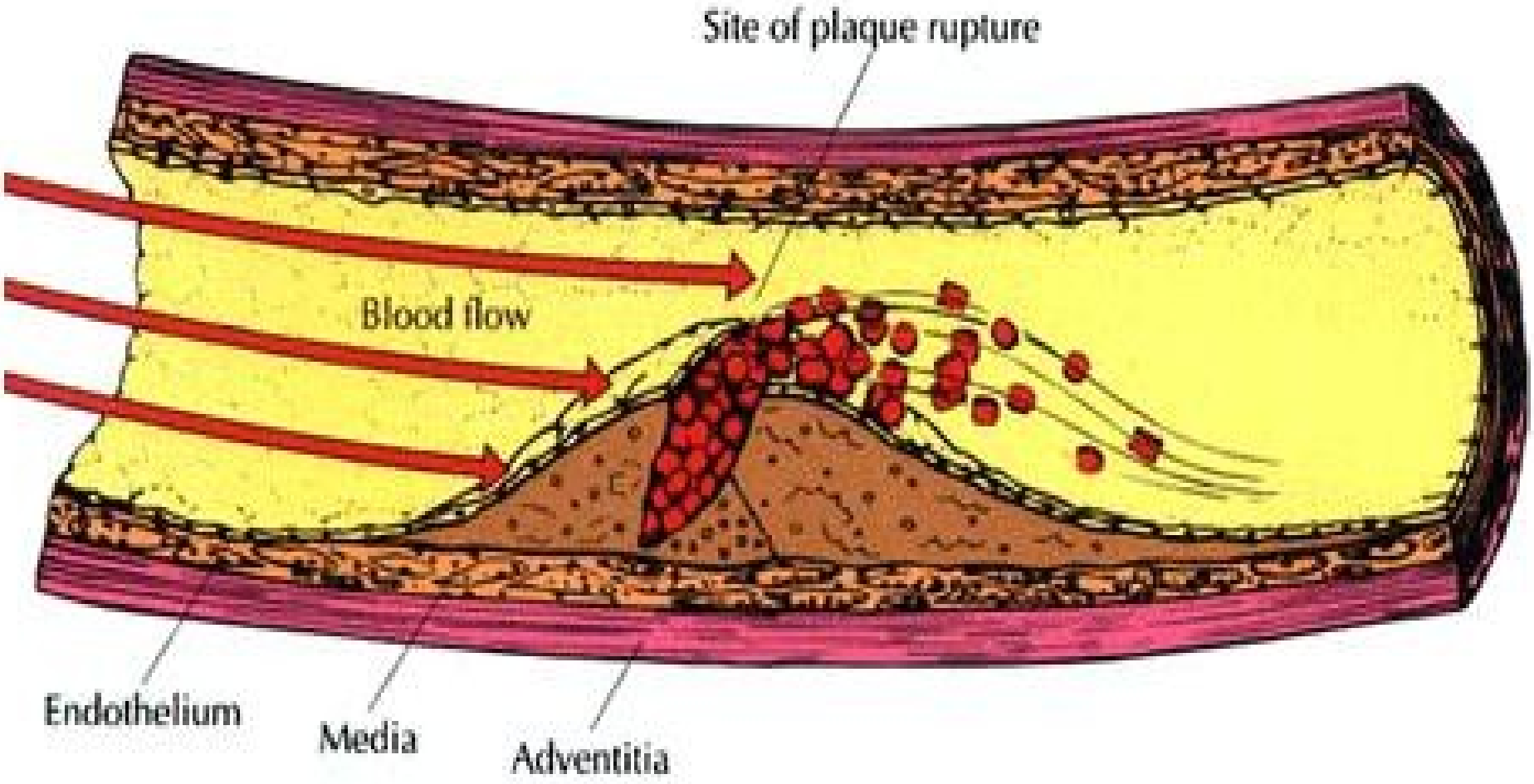
Culprit Lesions

Severity of Coronary Stenoses at initial angiogram
30.2 months before myocardial infarction in 329 pts



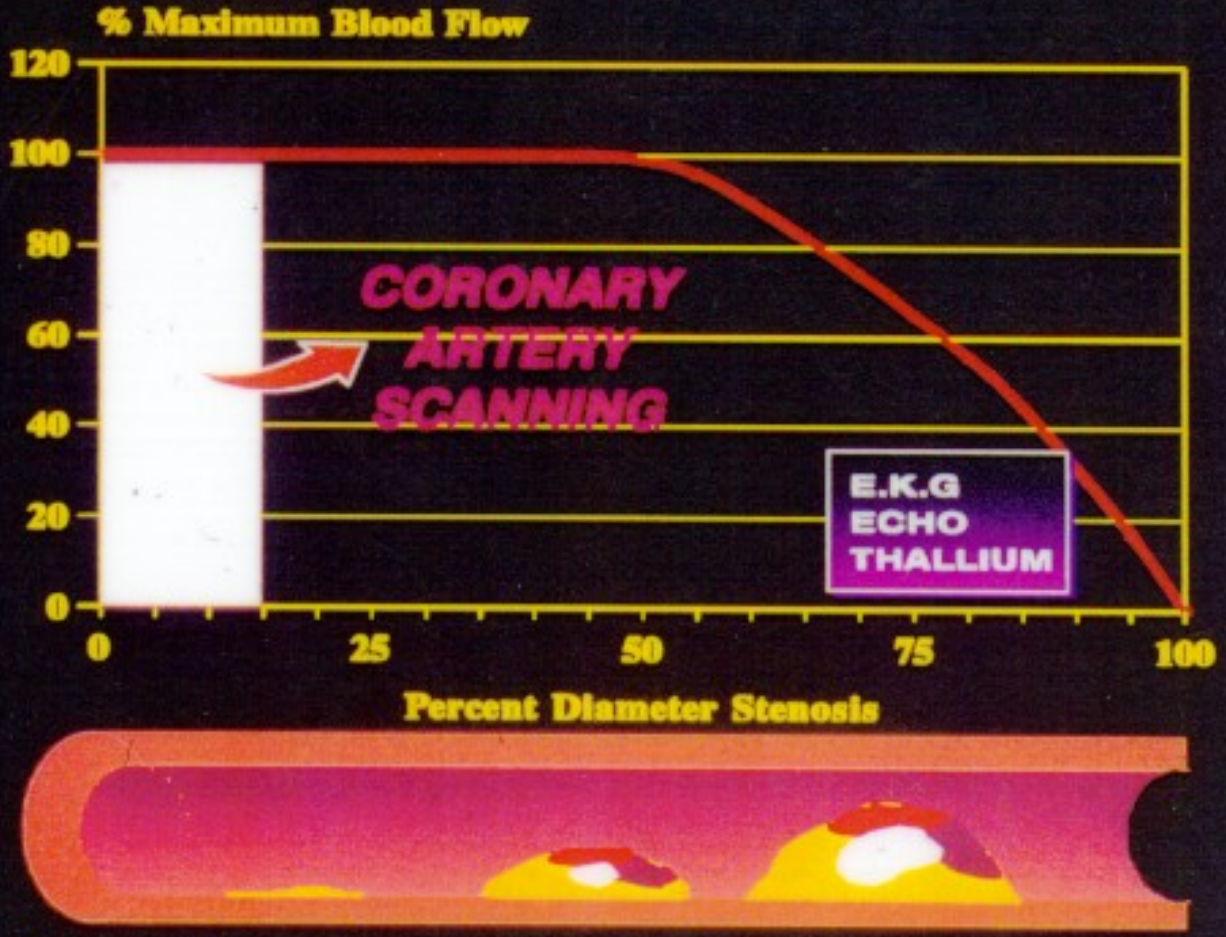
Am J Cardio 1997;80(9A):2I-10I

PLAQUE RUPTURE

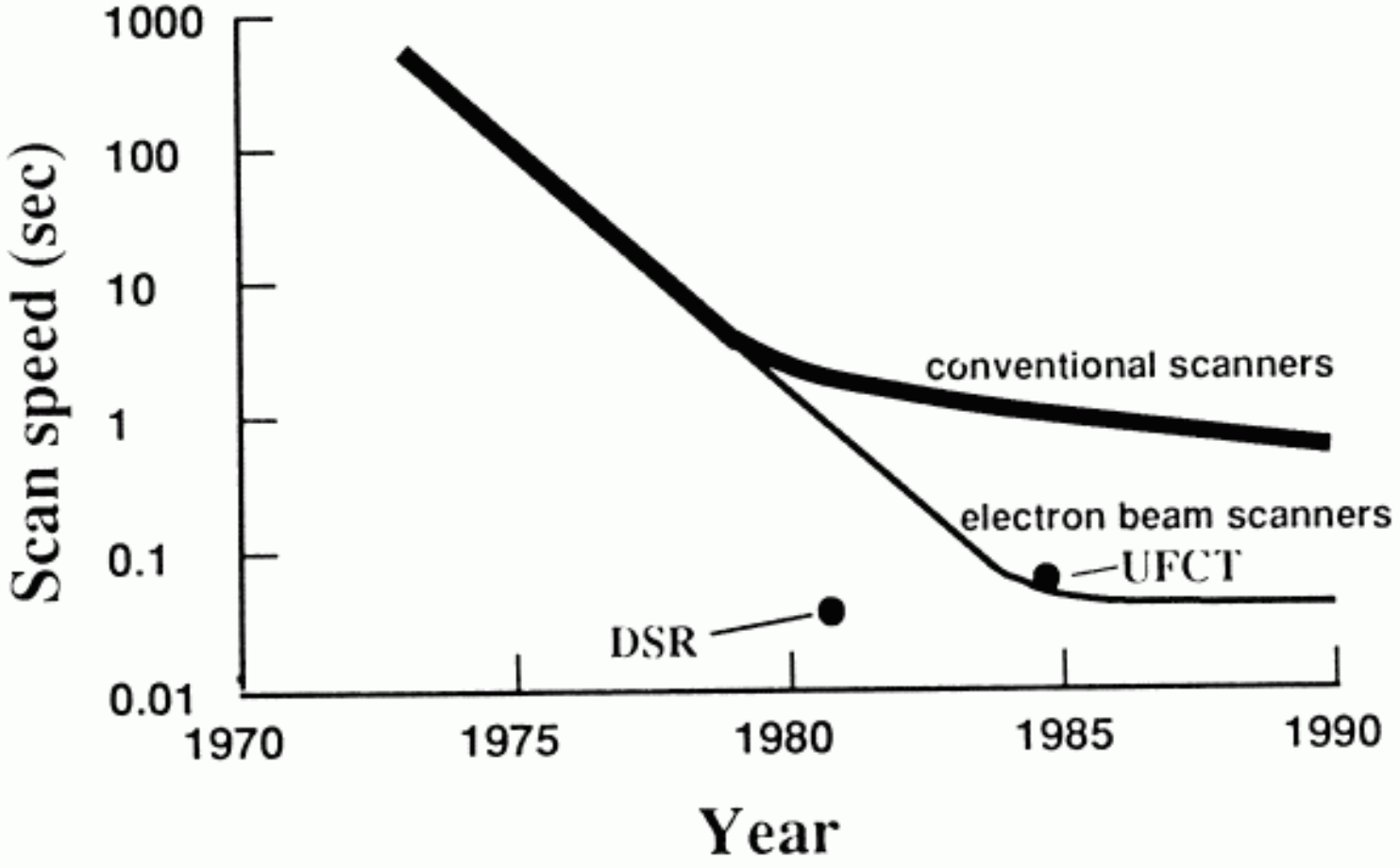


MAXIMUM BLOOD FLOW vs STENOSIS

Flow ≈ Normal Up To 60-70% Stenosis

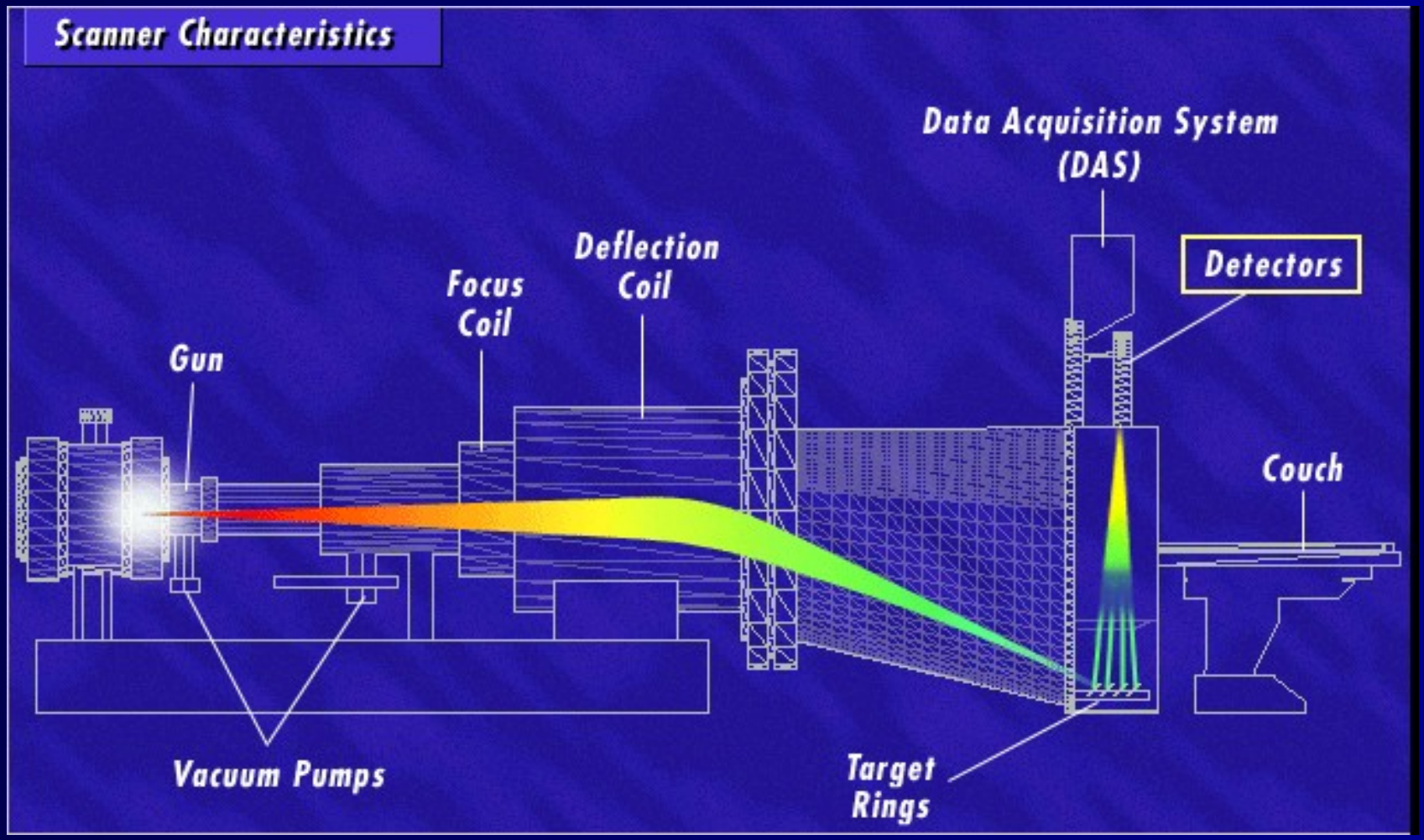


The Evolution of CT Speed

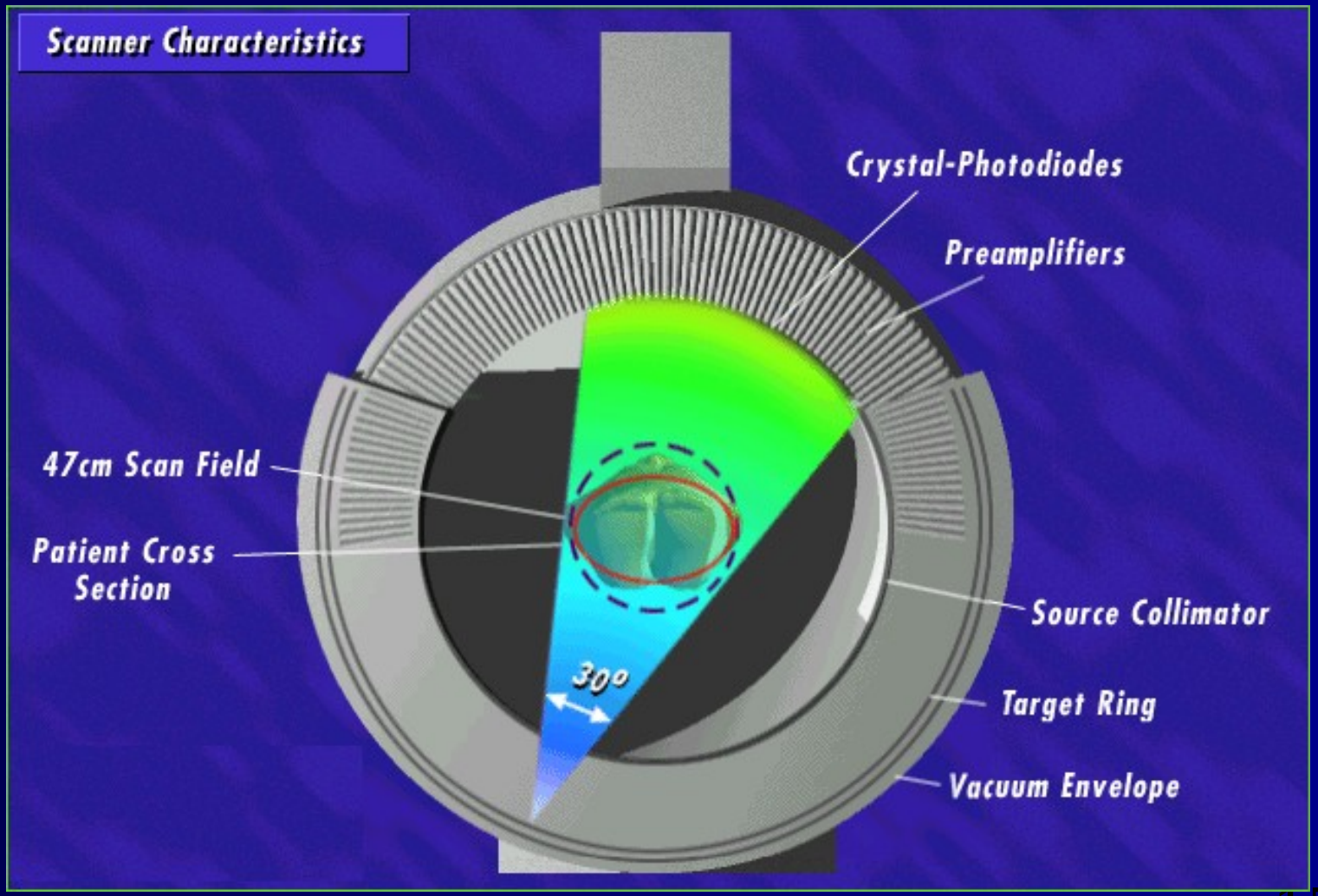


EBCT Scanner Appearance

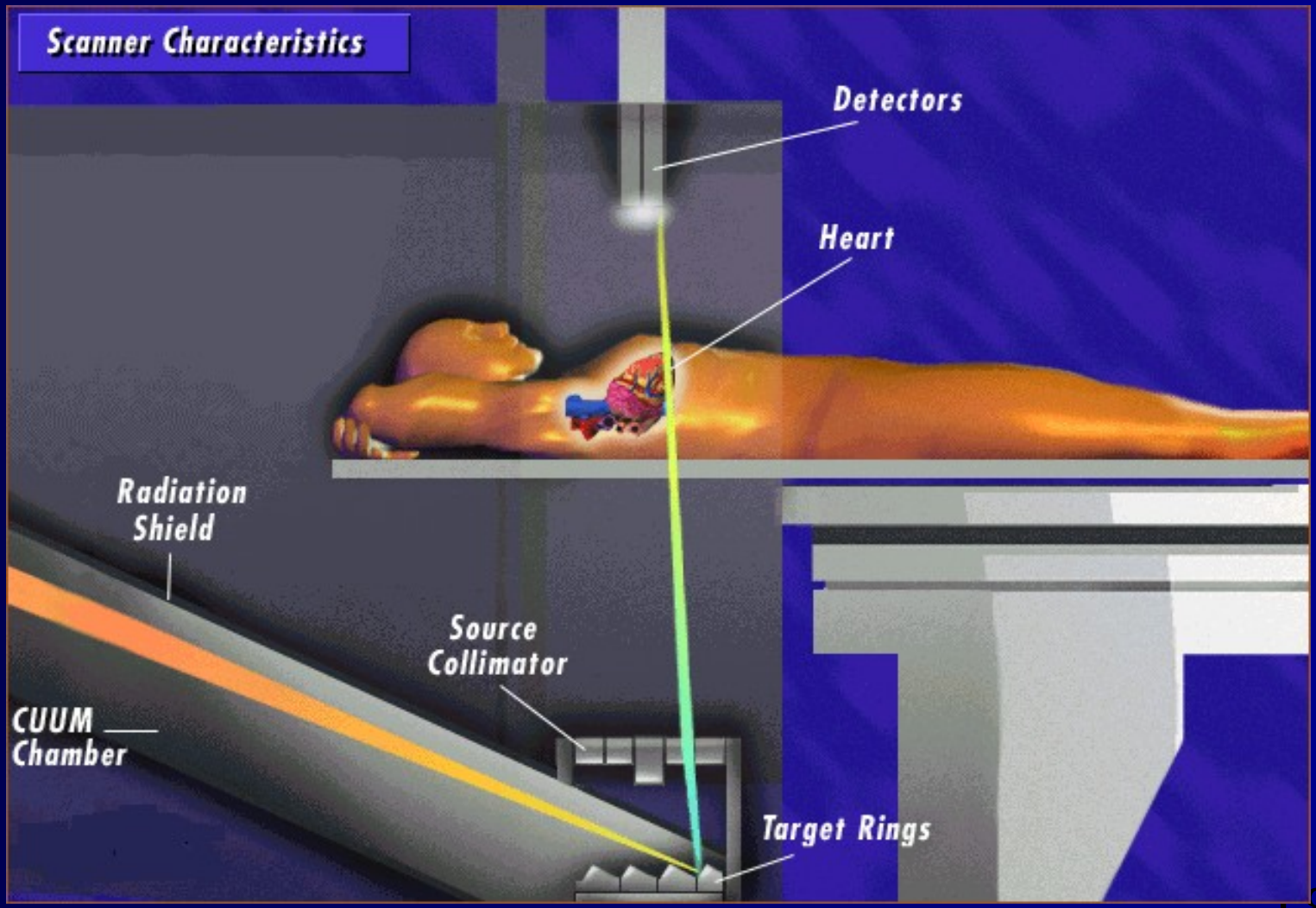
EBCT Inner Workings



Why is it “Ultrafast?”



EBCT Multislice Capability



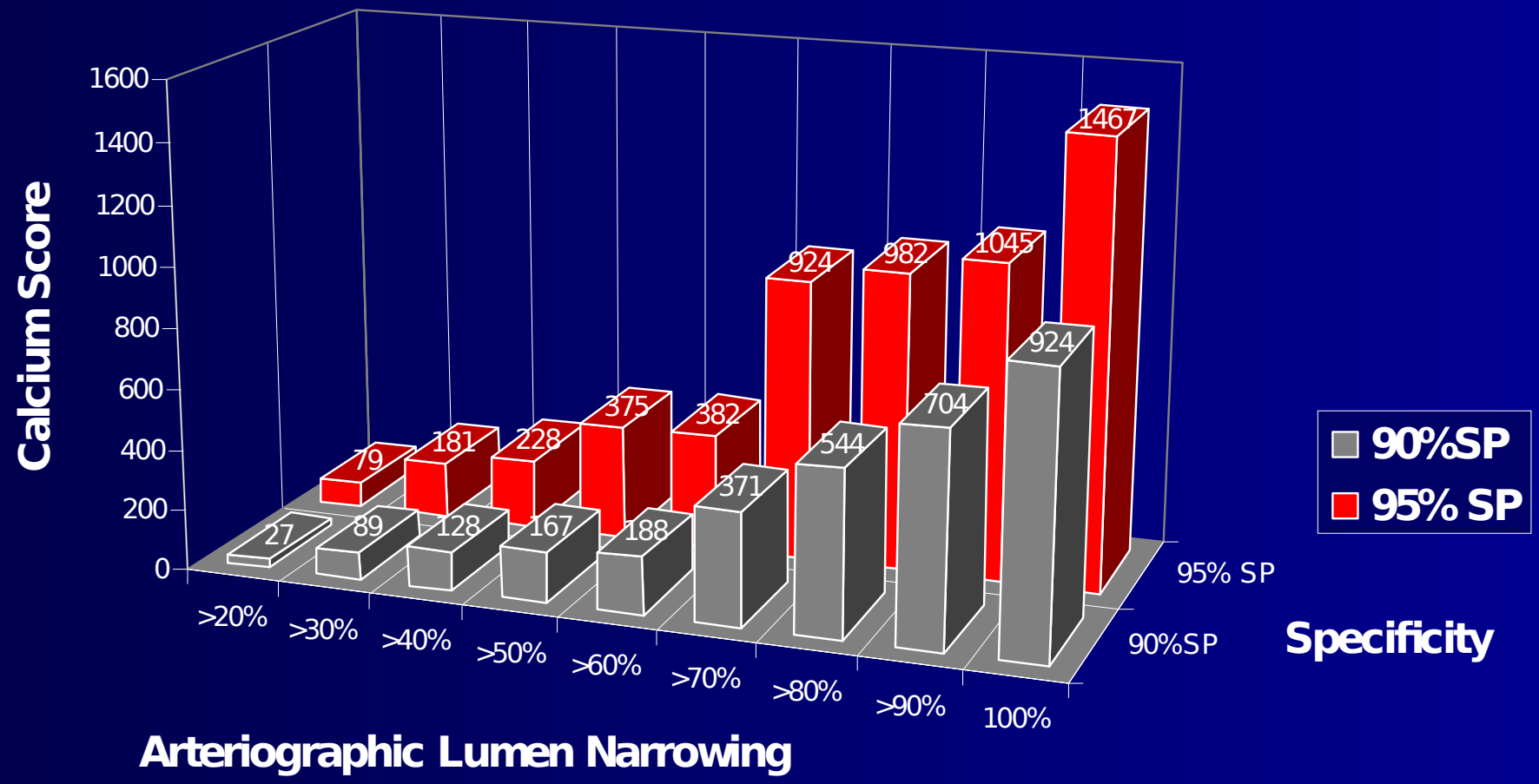
Scoring Criteria

EBCT uses the Agatston criteria:

Agatston Calcium Score	Significance
0-10	No evidence (or insignifica calcific disease
11-99	Mild plaque
100-399	Moderate plaque
>400	Heavy plaque

Population Statistics for EBCT

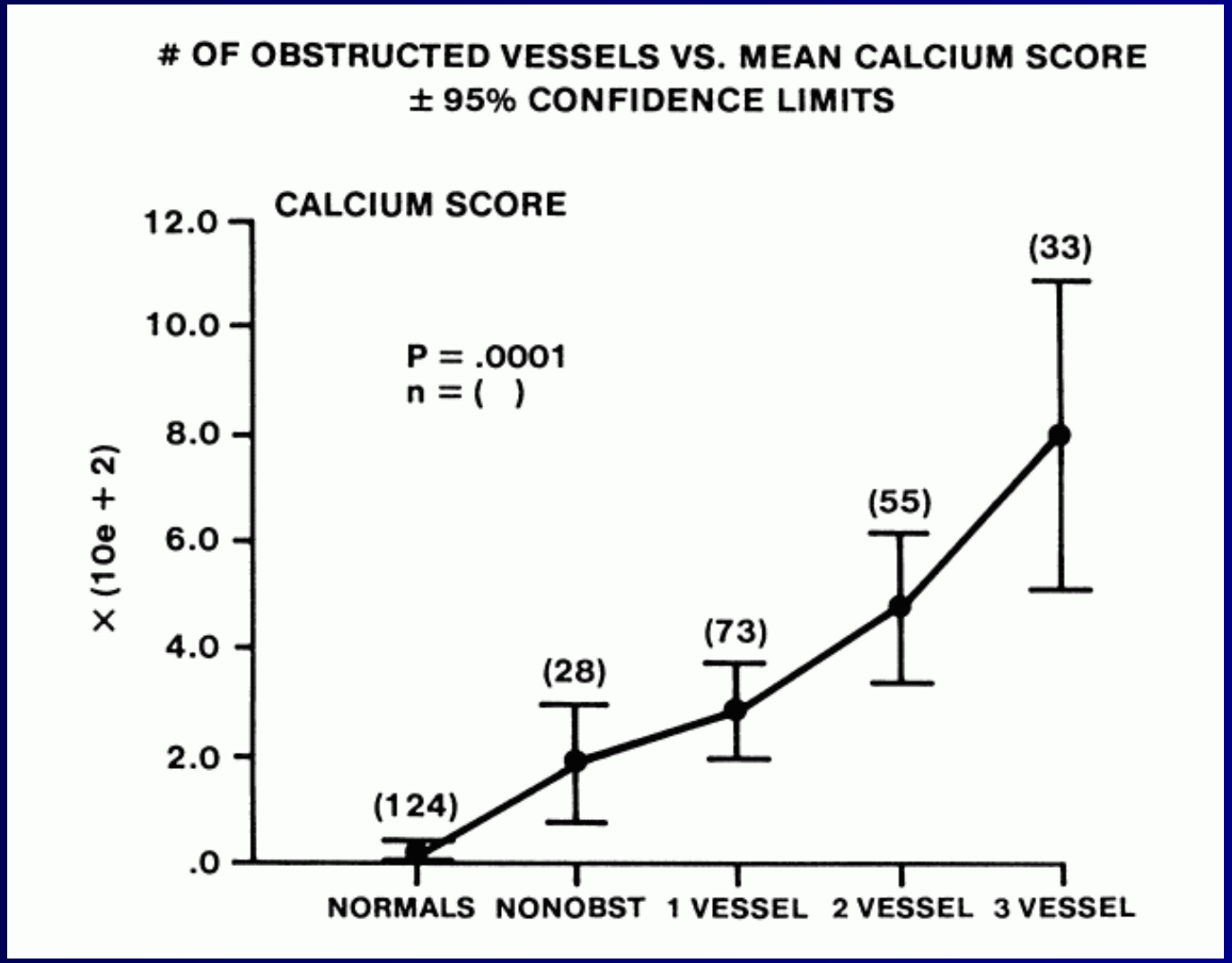
Age					Age		
	CAC Scores in 19,200 Asymptomatics						
Percentiles							
Age	40-45	46-50	51-55	56-60	61-65	66-70	70+
Men (13,973)							
10	0	0	0	1	1	3	3
25	0.5	1	2	5	12	30	65
50	2	3	15	54	117	166	350
75	11	36	110	229	386	538	844
90	69	151	346	588	933	1151	1650
Women (5,227)							
10	0	0	0	0	0	0	0
25	0.1	0.1	0.1	0.2	0.5	1	4
50	0.1	0.1	1	1	3	25	51
75	1	2	6	22	68	148	231
90	3	21	61	127	208	327	698



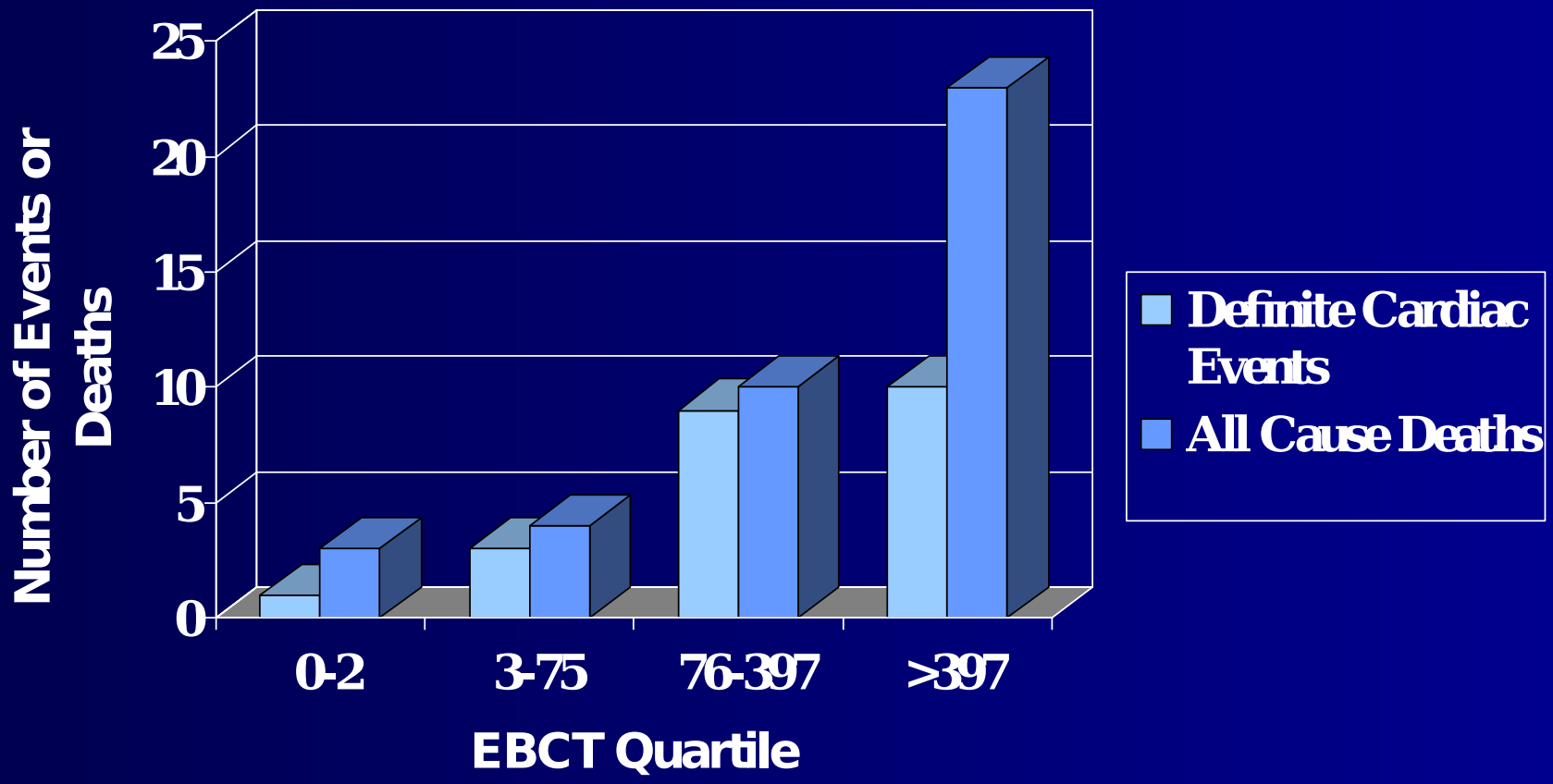
	>20%	>30%	>40%	>50%	>60%	>70%	>80%	>90%	100%
90%SP	27	89	128	167	188	371	544	704	924
95% SP	79	181	228	375	382	924	982	1045	1467

*Data from 213 patients referred for angiography at the Mayo Clinic. Consistent with data from over 1000 patients in the multi-center study reported by Budoff.

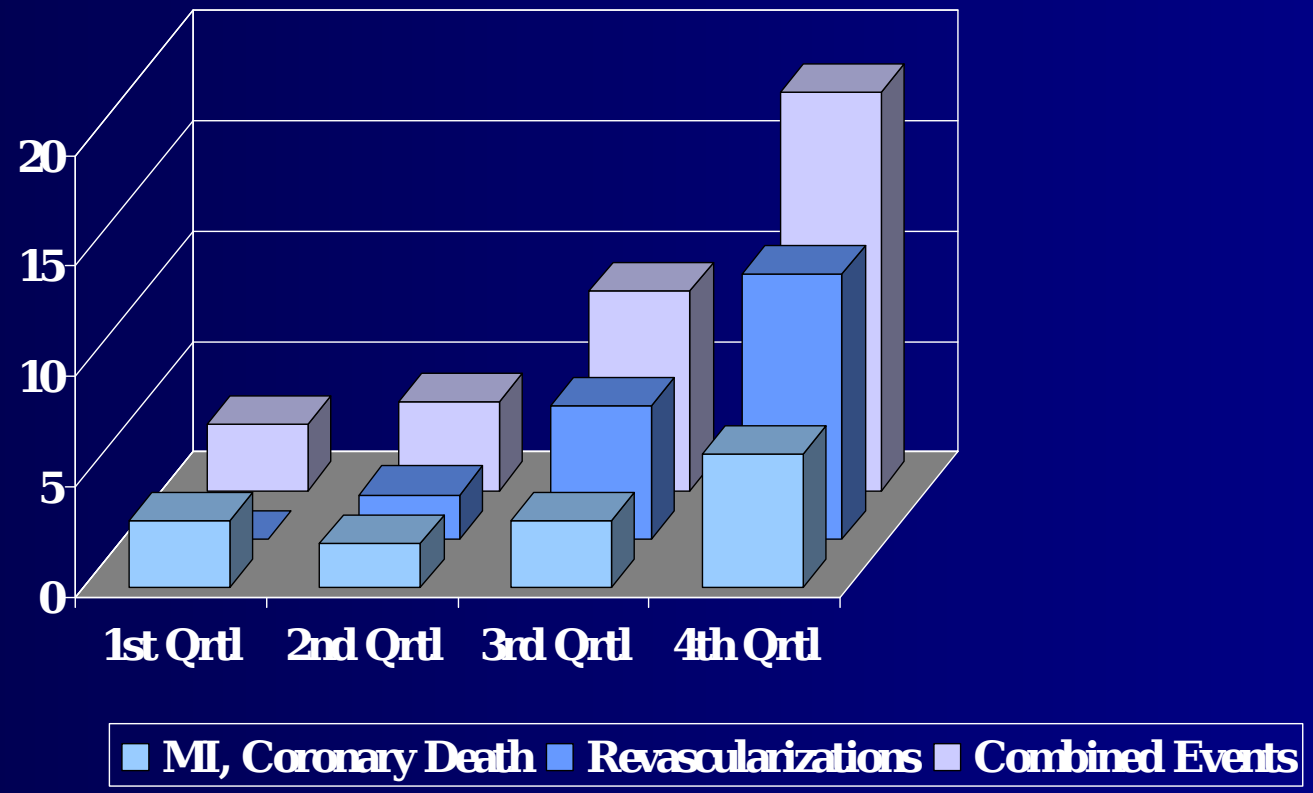
Calcium Score vs. Obstruction



Relation of Quartile to Prognosis for Cardiac and All-Cause Deaths



Prognosis for Cardiac Events -- 24 Months After EBCT



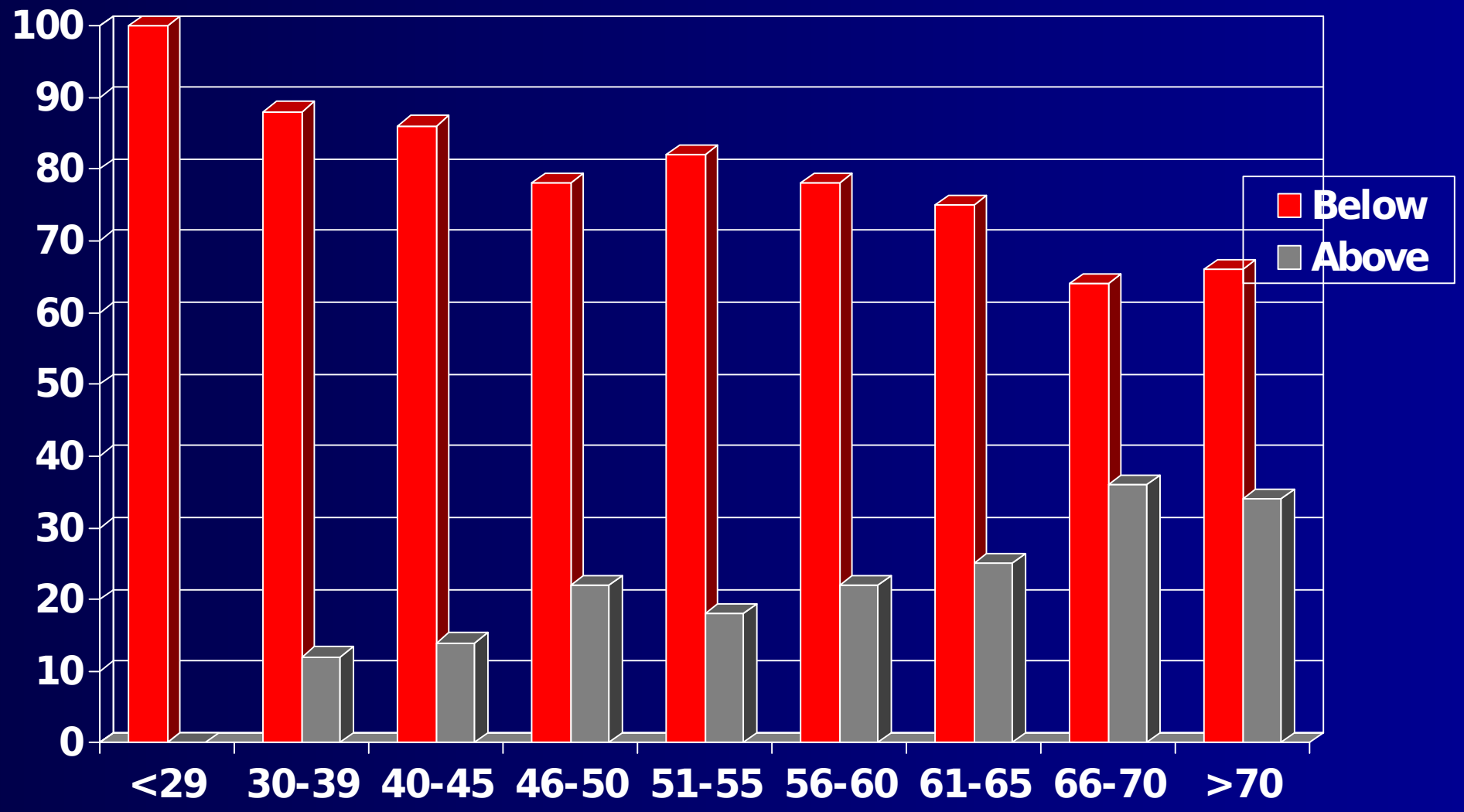
Number of Examinations

- 1 Aug 97 - 1 Feb 99 - >3000 EBCT examinations
- Most: coronary artery screening evaluations
- Small number:
  - congenital heart disease
  - Kawasaki disease
  - pulmonary embolism
  - anomalous coronary circulation
  - pericardial disease
  - evaluation of airway disease and anatomy

Age Distribution

- **Total patients:** **34.8% are 40-50 yrs**
  42.6% are 51-60 yrs
  11.8% are 61-70 yrs
- **Percentage of women increases slightly with each age category**

Percent of Patients in Top Quartile for Age



EBCT Predicts Coronary Events

- Arad, 1996, “Predictive value of EBCT of the coronary arteries. 19-month follow-up of 1173 asymptomatic subjects”
- 18 subjects had 26 cardiovascular events: 1 death, 7 MI, 8 CABG, 9 angioplasties, 1 stroke
- For CAC score thresholds of 100, 160, and 680, EBCT had sensitivities of 89%, 89%, and 90% and specificities of 77%, 82%, and 95%
- Odds ratios ranged from 20.0 to 35.4 ($P < .0001$)
- EBCT scores in top quartile better than conventional factors for short term prediction

EBCT Score Cutpoints

- Rumberger, 1997, EBCT coronary calcium score cutpoints and severity of associated angiographic lumen stenosis
- Established EBCT scores for 90% sensitivity and specificity at varying degrees of angiographic obstruction, determined an “optimal score” cutpoint
- 20-30% diameter stenoses at ~100 units
- 50-70% diameter stenoses at ~400 units

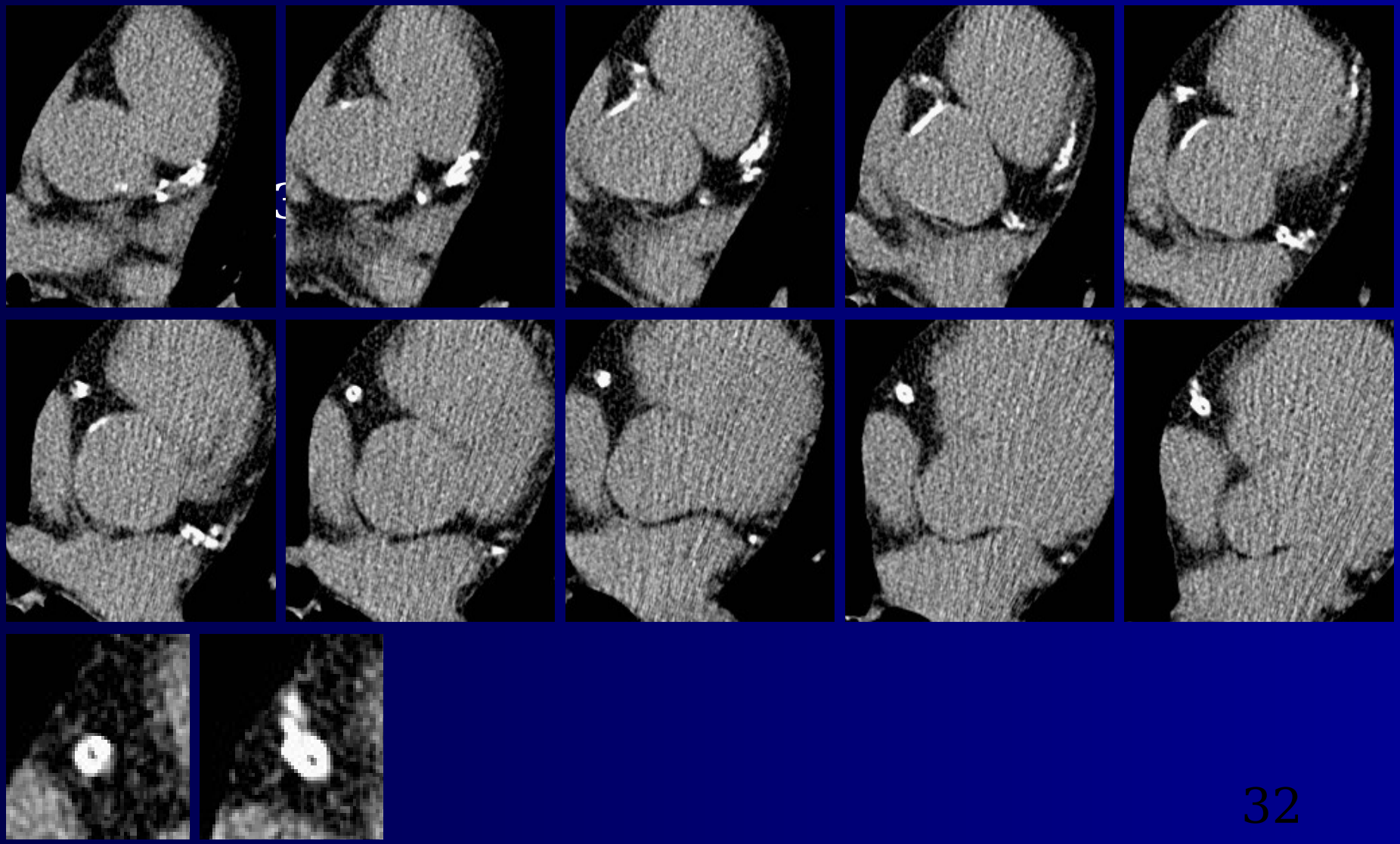
EBCT Predicts CAD

- Guerci, 1998, “Comparison of EBCT and conventional risk factor assessment for the prediction of angiographic CAD”
- For any coronary disease, highest quartile vs. lowest quartile, odds ratios for age, the ratio of total cholesterol to HDL cholesterol and calcium score, were 6.01, 3.14, and 94.08.
- For obstructive coronary disease, highest quartile vs. lowest quartile, the respective odds ratios for age, the ratio of total cholesterol to HDL and calcium score were 3.86, 4.11, and 34.12.

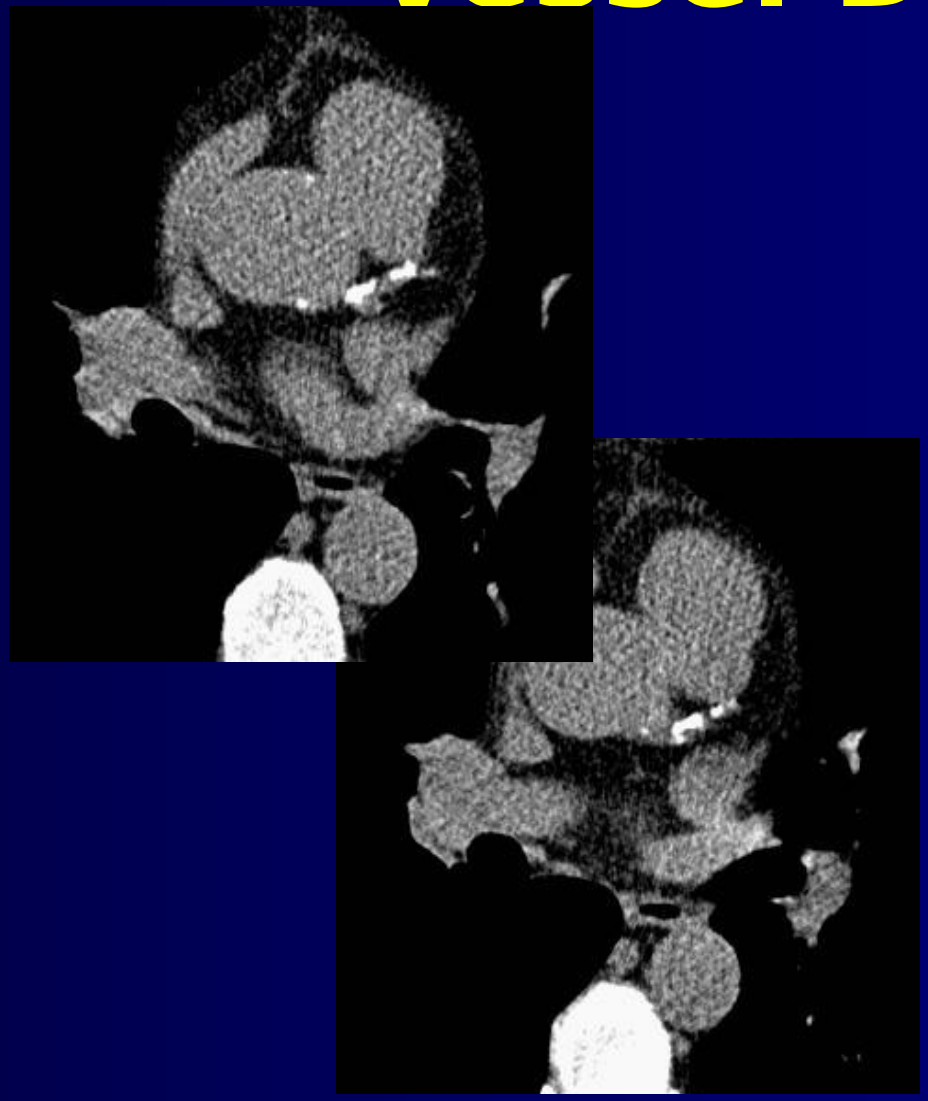
Silent Ischemia

- **Data presented by Mahmarian, et al, showed that 40% of patients with scores of >400 had ischemic myocardium >15% of the total left ventricular volume**
- **70% of patients with scores >1000**

63 y.o. Retired Naval Officer with High Cholesterol and Extensive Calcific Atherosclerosis



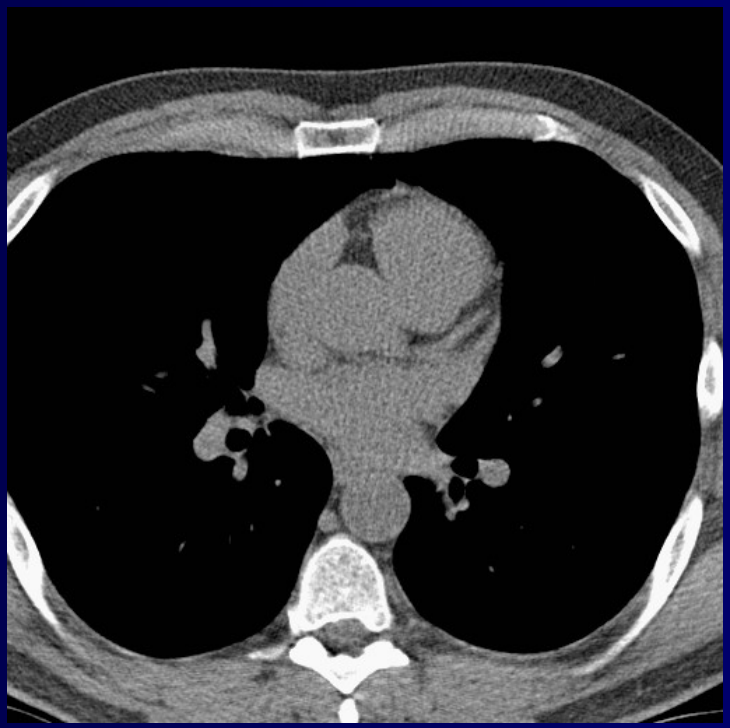
80% Lesions in Four Vessel Disease



- 62 y.o. man, strong family hx, TC 240, LDL 170
- EBCT score = 1166
- Subsequent cath showed 80% four vessel disease
- Revascularization

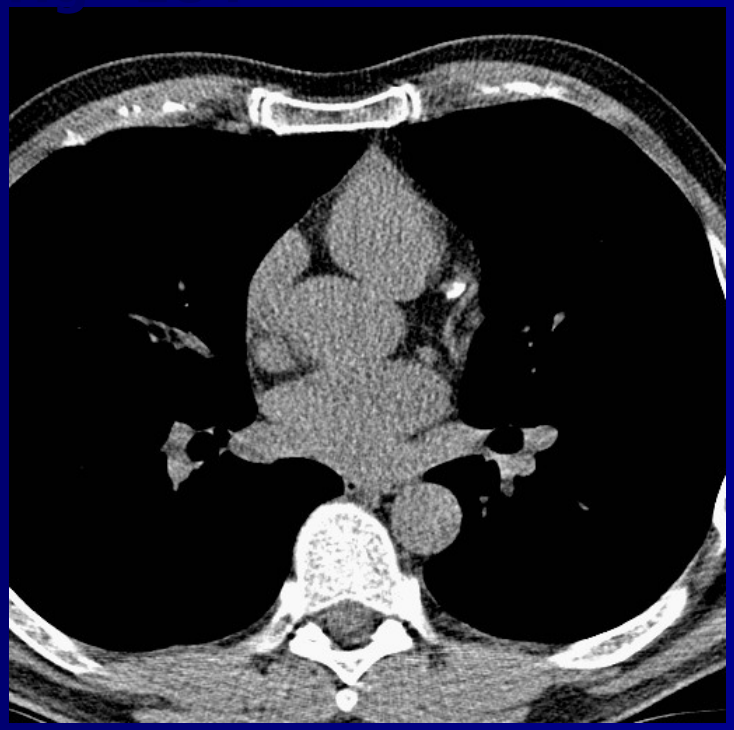
A Tale of Two Consecutive Patients

47 yo WM COL, +FH, ex-smoker, TC=234, HDL=32, Trig=209



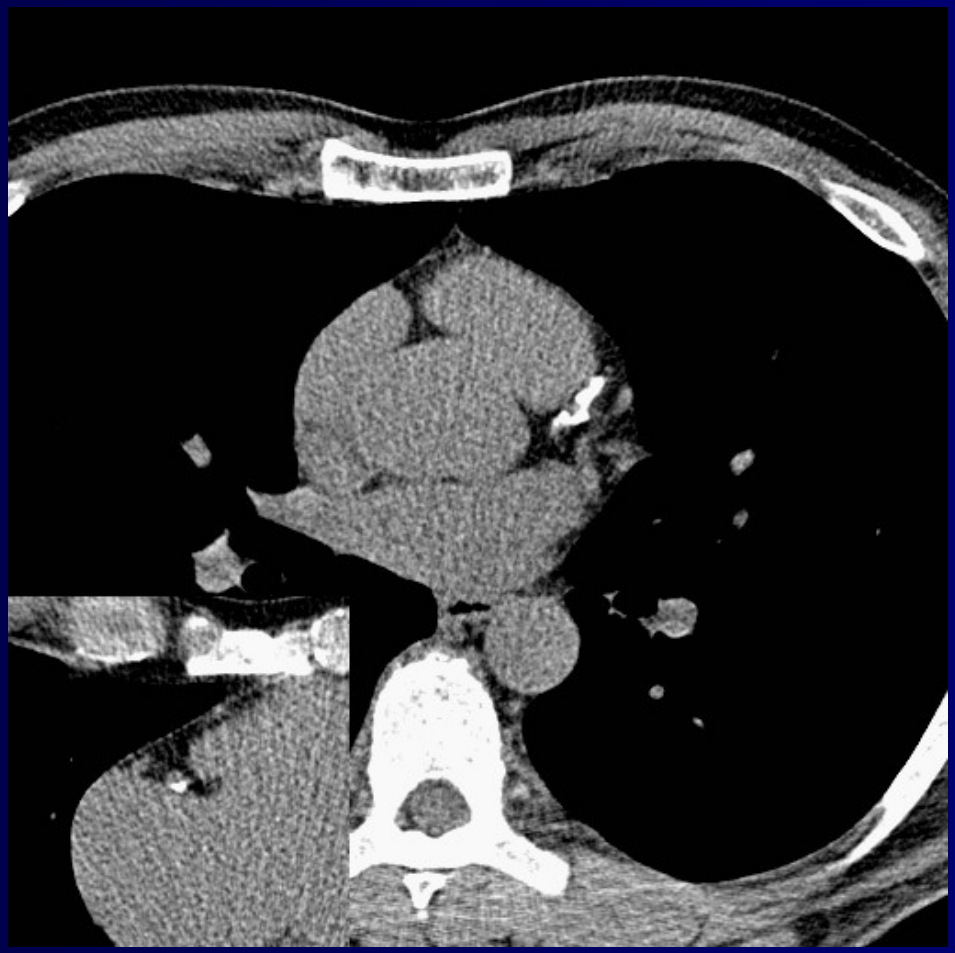
Calcium Score=0

48 yo WM LTC, marathons, TC=163, HDL=32, LDL=74, Trig=284



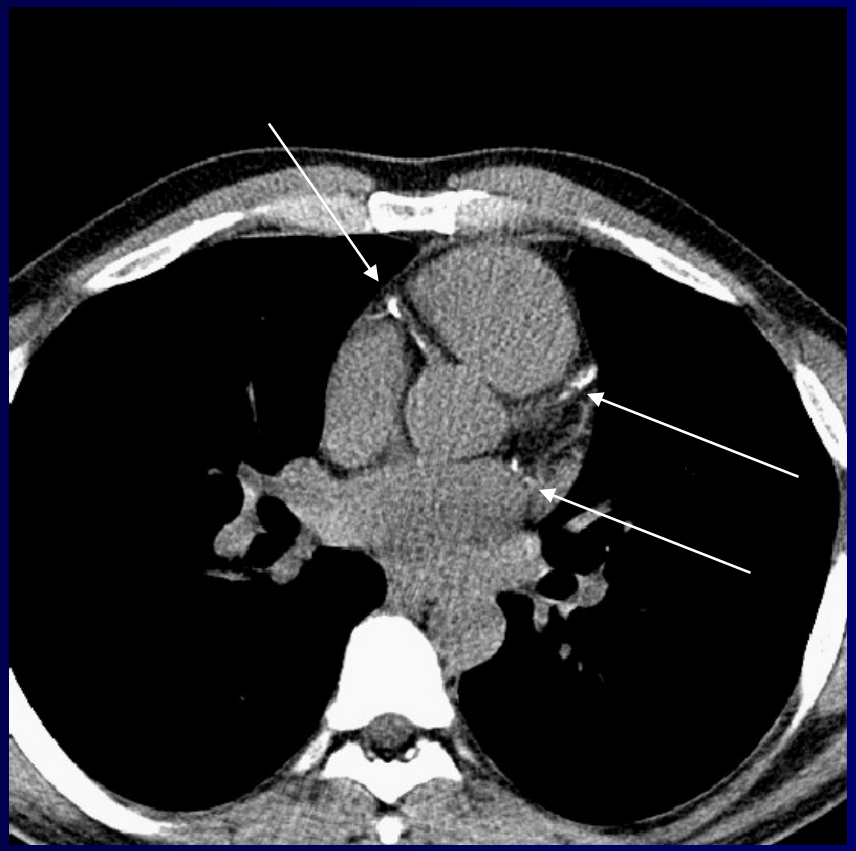
Calcium Score=160, upper 4th Quartile

55 y.o. General Officer



- High physical condition
- Mildly high TC=240-250, +FH, now on Statin and aspirin
- Calcium score=995, LAD=602, RCA=388

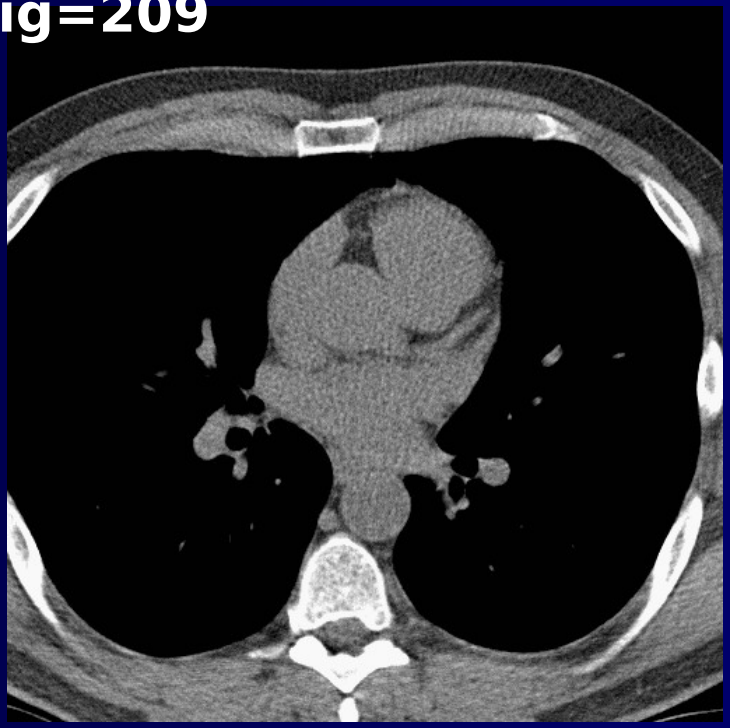
EBCT in Asymptomatic 45 y.o. Soldier



- Nl ETT 1995
- TChol 240; HDL 60; LDL 164; Trig 80
- +HTN, treated; Runs over 150 minutes/week; In excellent physical condition
- Calcium score=640; LAD=359; Cx=65; RCA=216;
- ETT abnormal; Angio=single vessel disease; Angioplasty

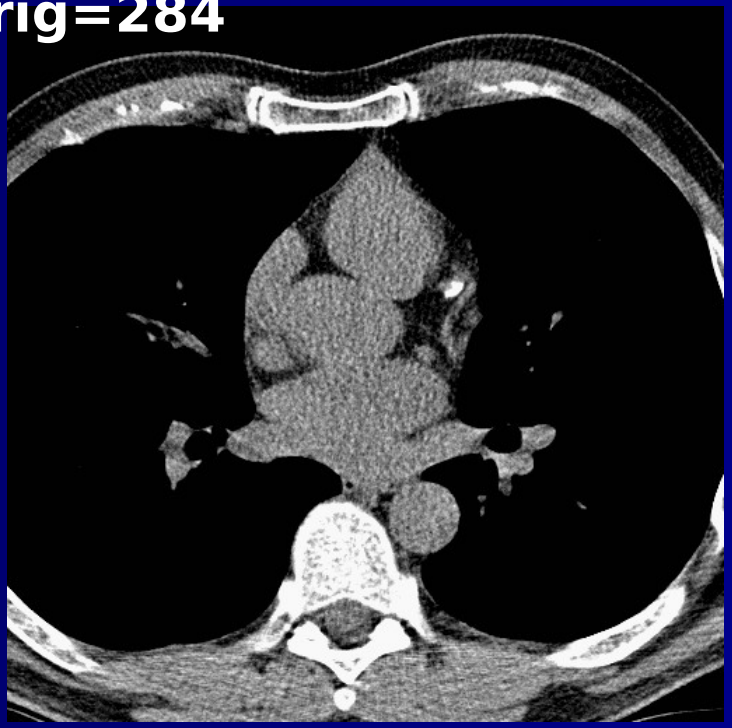
A Tale of Two Consecutive Patients

47 yo WM COL, +FH, ex-smoker, TC=234, HDL=32, Trig=209



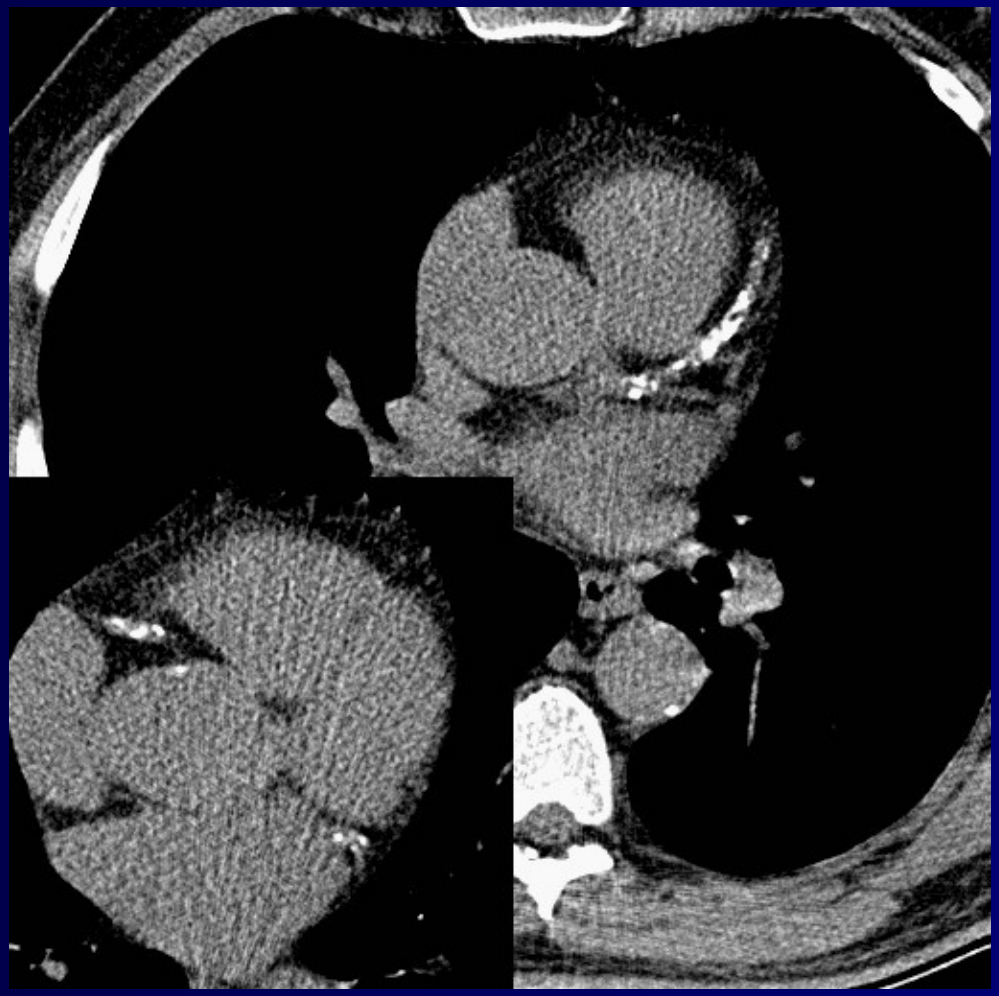
Calcium Score=0

48 yo WM LTC, marathons, TC=163, HDL=32, LDL=74, Trig=284



Calcium Score=160

75 year old Male



- Calcium score=944, LAD=657, CX=101, RCA=186
- Thallium results = moderate multifocal ischemia

35 year old Soldier

- 35 year old male
- Chest pain, angiography and angioplasty
- Calcium score = 667, triple vessel disease

Coronary Calcium

- **Coronary calcium can only represent coronary atherosclerotic disease.**
- **The amount of radiographic calcium parallels the amount of elemental calcium**
- **The amount of radiographic and anatomic calcium correlates to the amount of atherosclerotic plaque.**

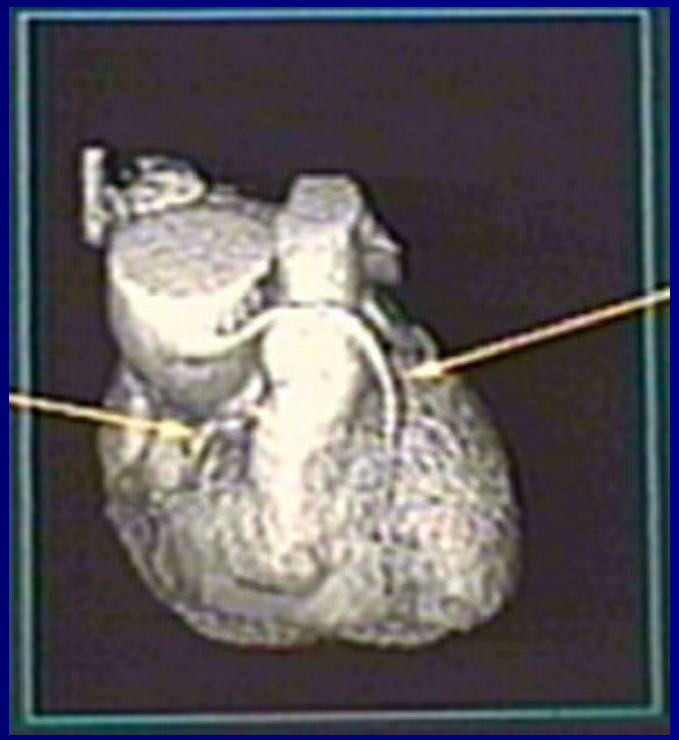
Coronary Calcium by EBCT

- **Only about 20-30% of a plaque matrix is calcified.**
- **The culprit lesion which leads to an acute occlusion, is usually a smaller, younger, lipid-rich plaque.**
- **This lesion lesion may not be heavily calcified, but it's usually in the company of more mature lesions which are calcified.**

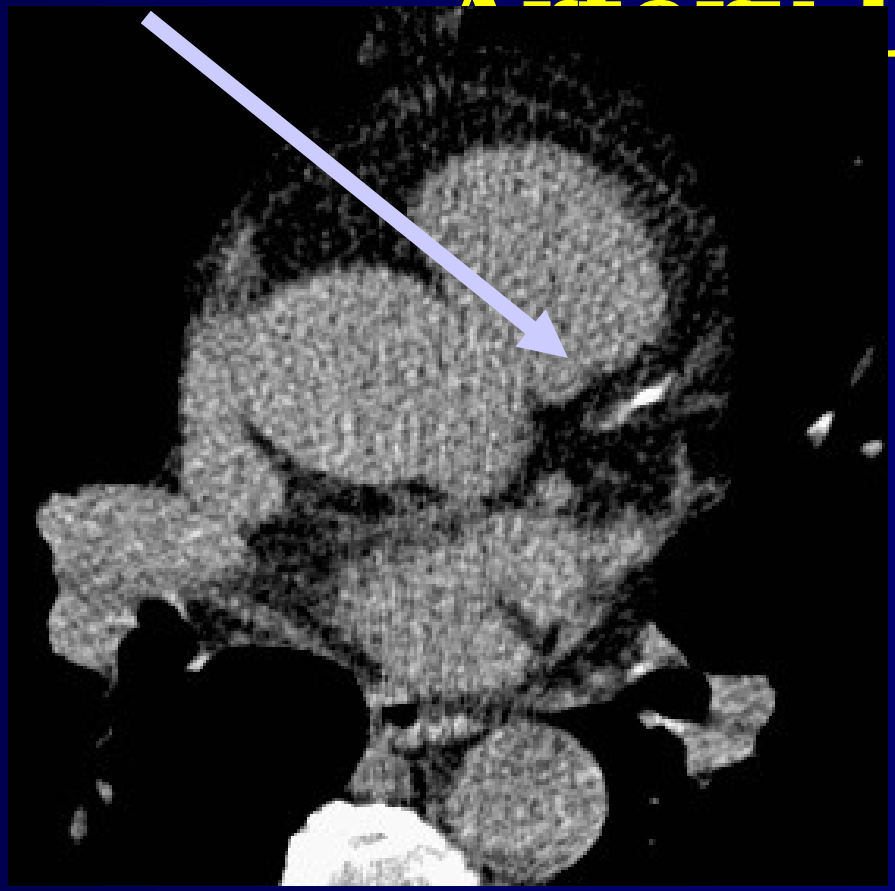
EBCT Recommendations

Calcium Score	Diagnosis	Clinical Interpretation
0 to 10	No identifiable artherosclerotic plaque	A “negative” examination. Sensitivity: >90-95%
11 to 100	Mild plaque burden Moderate CV Risk	Likely mild or minimal coronary stenosis
101 to 400	Moderate plaque burden Mod-High CV Risk	Moderate non-obstructive CAD highly likely

3D CT Coronary Angiography



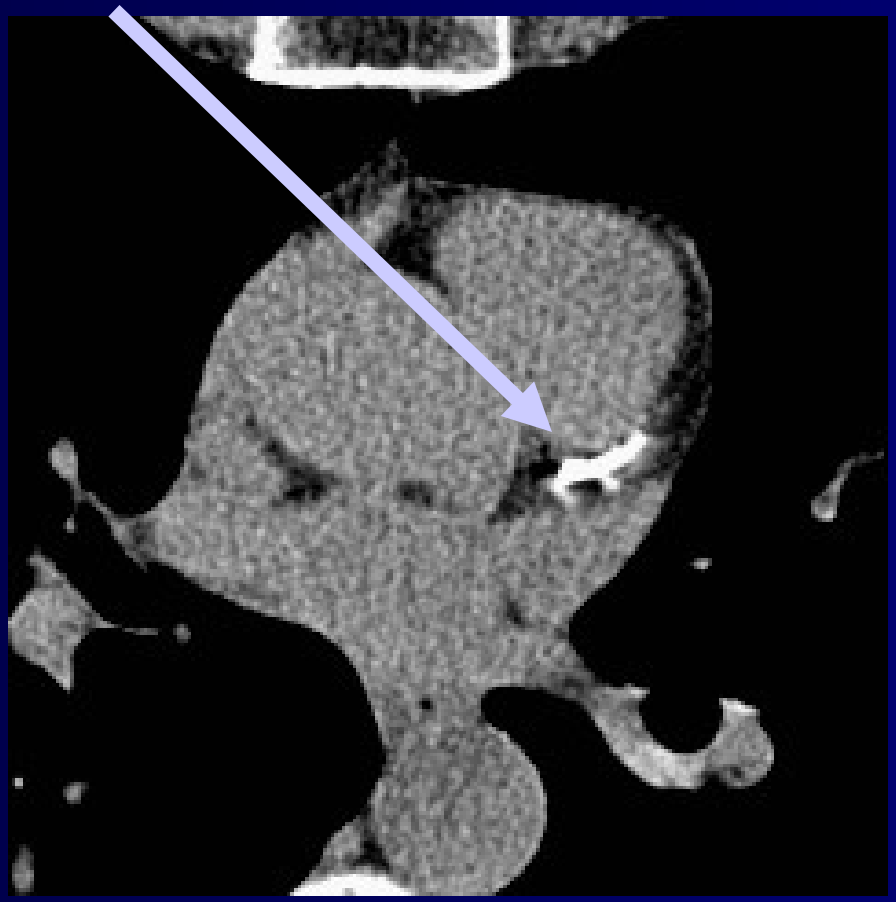
EBCT Allows Early Detection of Early, Preventable Coronary Artery Disease



- 55 year old man
- Calcium score = 38
- This is a fairly low score which would indicate a good prognosis, and by itself requires only minor lifestyle modifications.

Drs. Feuerstein and COL Brazaitis, MSG Dance, WRAMC EBCT, 1999

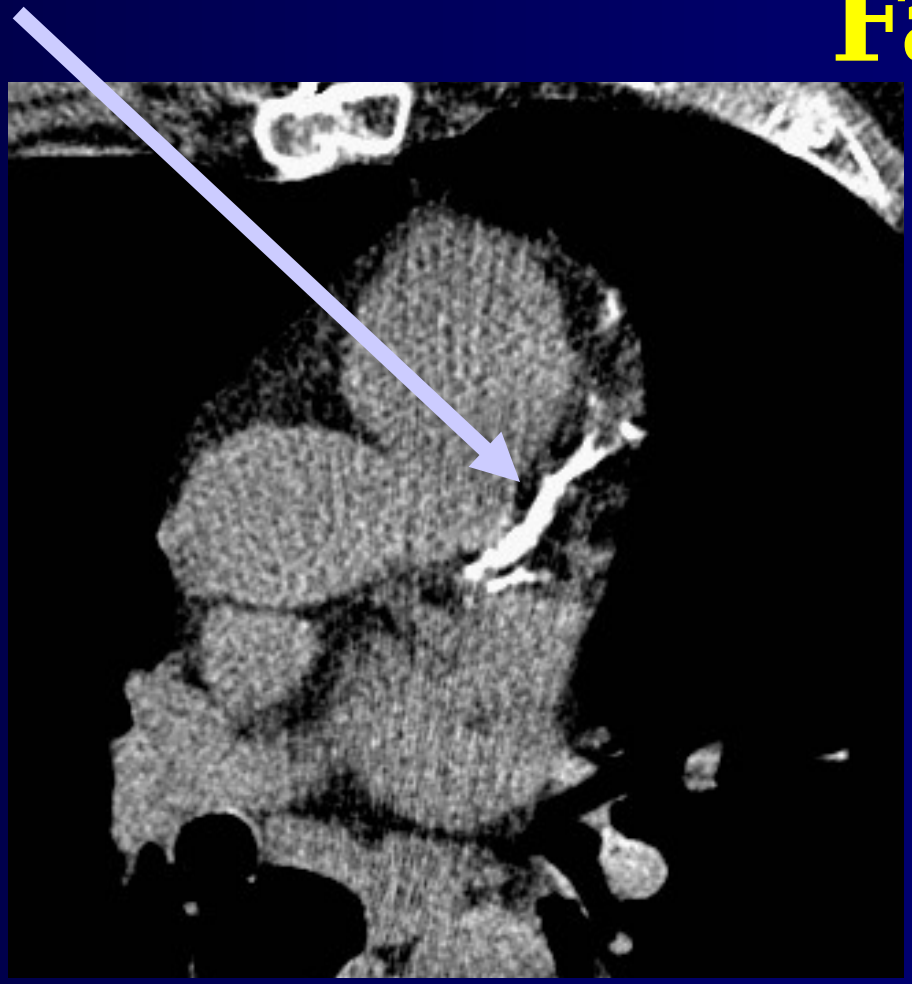
EBCT Allows Early Detection of Advanced, Treatable Coronary Artery Disease



- 55 year old man
- Calcium score = 800
- This is a rather high score, indicating a higher risk for heart attacks or sudden death in the next few years.
- But this can be attacked with medicines!!

Drs. Feuerstein and COL Brazaitis, MSG Dance, WRAMC EBCT, 1999

Maybe with EBCT, It Doesn't Have to Get This Far



- 65 year old man, Calcium Score = 2700
- This is a huge score, but it is too late because he has already had his MI and CABG.
- EBCT could have detected this man two decades earlier, allowing preventative measures.

Drs. Feuerstein and COL Brazaitis, MSG Dance, WRAMC EBCT, 1999

Primary vs. Secondary Prevention of Coronary Heart Disease

- If one waits for symptoms, the opportunity for primary prevention has passed.
- With new treatment regimens, coronary artery plaque can be slowed, stalled, or reversed.
- Most of the data has come from the highest risk populations.

"Longevity is a vascular question…
A man is only as old as his arteries.
Arterio-Sclerosis results from the bad
use of good vessels….."

Osler, 1892